

**WHAT IS CLAIMED IS:**

1. A compound of the formula R1-R2-R3, wherein:  
R1 comprises a moiety that binds to the hemoglobin binding site on cytochrome b<sub>5</sub> and competitively inhibits hemoglobin binding to cytochrome b<sub>5</sub>;  
R3 comprises a moiety that binds to cytochrome b<sub>5</sub> at a site distinct from the site at which R1 binds to cytochrome b<sub>5</sub>;  
R2 comprises a moiety that links R1 and R3.
2. The compound of claim 1, wherein R1 is a linear polyamine.
3. The compound of claim 1, wherein R1 is a cyclic polyamine.
4. The compound of claim 1, wherein R1 is a hexacyclen.
5. The compound of claim 1, wherein R1 is a moiety that binds to cytochrome b<sub>5</sub> at one or more amino acids selected from the group consisting of H26, E43, E44, E48, A54, D60, H80 and A88.
6. The compound of claim 1, wherein R3 is a moiety that binds to the ATP binding site on cytochrome b<sub>5</sub>.
7. The compound of claim 1, wherein R3 is ATP or an ATP analog.
8. The compound of claim 1, wherein R3 is  $\beta$ -nicotinamide adenine dinucleotide.
9. The compound of claim 1, wherein R3 is ATP; 1,N6-ethenoadenosine 5' triphosphate;  $\beta$ -nicotinamide adenine dinucleotide; 1,N6-ethenoadenosine hydrochloride; nicotinamide-1,6-ethenoadenosine; or coenzyme A.

10. The compound of claim 1, wherein R3 is a moiety that binds to cytochrome b<sub>5</sub> at one or more amino acids selected from the group consisting of I24, L25, H26 and H27.
11. The compound of claim 1, wherein R1 is hexacyclen and R3 is  $\beta$ -nicotinamide adenine dinucleotide.
12. The compound of claim 1, wherein R2 is a flexible linker.
13. The compound of claim 1, wherein R2 is a moiety that covalently crosslinks R1 and R3.
14. The compound of claim 1, wherein R2 is a polyglycine moiety.
15. The compound of claim 1, wherein R2 is a polyglycine moiety containing between 1 and 3 glycines.
16. The compound of claim 1, wherein R2 is polyethylene glycol (PEG); polystyrene-PEG; [2-(2-aminoethoxy)ethoxy] acetic acid; allyloxycarbonyl- [2-(2-aminoethoxy)ethoxy] acetic acid; fluorenyl-methoxycarbonyl-[2-(2-aminoethoxy)ethoxy] acetic acid; ter-butyloxycarbonyl-[2-(2-aminoethoxy)ethoxy] acetic acid; benzyloxycarbonyl-[2-(2-aminoethoxy)ethoxy] acetic acid; or BMPS (N-( $\beta$ -maleimido-propyloxy)succinimide).
17. The compound of claim 1, wherein R2 is a straight chain or branched chain hydrocarbon.
18. The compound of claim 1, wherein said compound binds to cytochrome b<sub>5</sub> and inhibits the activity of cytochrome b<sub>5</sub> in the reduction of methemoglobin to hemoglobin.

19. A pharmaceutical composition comprising the compound of claim 1 or a pharmaceutically acceptable salt thereof.

20. A method of reducing the incidence of red blood cell sickling in a patient with sickle cell disease, comprising administering an effective amount of the compound of claim 1 to the patient.

21. A method of raising the level of methemoglobin in blood, comprising adding an effective amount of the compound of claim 1 to the blood.

22. The method of claim 21, wherein the compound is added to the blood *ex vivo*.

23. A method of raising the level of methemoglobin in the blood of a patient, comprising administering an effective amount of the compound of claim 1 to the patient.